
Reconnaissance Report - Section 205

Modification to Existing
Local Flood Protection Project
Springfield, Massachusetts

Local Flood Protection

December 1987



US Army Corps
of Engineers
New England Division

SYLLABUS

This Reconnaissance Report was prepared under the special continuing authority contained in Section 205 of the 1948 Flood Control Act, as amended, to investigate the feasibility of improving the existing Local Flood Protection Project (LPP) at Springfield, Massachusetts. Studies contained in this report determined that raising the existing floodwalls one-foot was potentially feasible and further study was warranted. This plan would increase the level of protection at Springfield from a 450-year event to a 500-year event and reduce the expected annual damages from \$272,000 to \$147,000. Total costs for completing detailed studies are estimated at \$86,000 (cost sharing is 50 percent Federal and 50 percent non-Federal) and total project costs are estimated at \$1,250,000 (cost sharing is 75 percent Federal and 25 percent non-Federal). The benefit to cost ratio is 1.11 to 1.

**RECONNAISSANCE REPORT
MODIFICATION TO EXISTING LOCAL FLOOD PROTECTION PROJECT
SECTION 205
SPRINGFIELD, MASSACHUSETTS
DECEMBER 1987**

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**MODIFICATION TO
EXISTING LOCAL FLOOD PROTECTION PROJECT
SPRINGFIELD, MASSACHUSETTS**

RECONNAISSANCE REPORT

Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9159

December 1987

1. AUTHORIZATION

This report provides results of reconnaissance scope investigations accomplished under the special continuing authority contained in Section 205 of the 1948 Flood Control Act, as amended. Under the provisions of Section 205, funding is available for small flood control and related projects not specifically authorized by Congress. Work accomplished under this authority must be complete-in-itself and not commit the United States to any additional improvement to insure its successful operation. The project must be economically justified and advisable in the opinion of the Chief of Engineers. Federal participation under Section 205 is limited to \$5 million. The Mayor of Springfield requested that the Corps perform a reconnaissance study for flood control in letter dated 14 March 1986 (see Enclosure 1).

2. PURPOSE AND SCOPE

The purpose of this study is to investigate the feasibility of improving the existing Local Flood Protection Project (LPP) at Springfield, Massachusetts, and determine whether there is a Federal interest to proceed to more detailed studies. A preliminary study indicated that raising the existing floodwalls by one-foot was potentially feasible.

3. PRIOR STUDIES/REPORTS

November 1985: The Corps of Engineers, New England Division (NED), prepared an appraisal report which provided for the review of the existing LPP's authorized by Congress. The report concluded that adding a one-foot concrete cap to the existing flood walls was *potentially feasible*. The construction costs assumed that a new cost-effective method of epoxying the one-foot concrete cap to the floodwall as accomplished on the nearby West Springfield LPP would be incorporated.

May 1982: The Corps of Engineers, NED prepared a Detailed Project Report to determine the feasibility of providing additional flood protection for the existing LPP's at West Springfield and Springfield, Massachusetts. Although the report recommended raising the floodwall at West Springfield, raising the wall at Springfield was not economically justified at that time. Project costs were based on a more costly method of raising the wall than by the method recommended in the November 1985 report described above.

4. DESCRIPTION OF STUDY AREA

The city of Springfield is located in western Massachusetts on the Connecticut River approximately 76 miles upstream of its confluence with the Atlantic Ocean. The Connecticut River basin (see Enclosure 2) has a drainage area of 9,587 square miles at Springfield. The study area is at the existing Local Flood Protection Project located in the western portion of the city's downtown area (see Enclosure 3).

5. EXISTING LOCAL FLOOD PROTECTION PROJECT

The Springfield Local Protection Project is approximately 4.5 miles long and located along the east bank of the Connecticut River (see Photographs). The project provides protection for two large floodplain areas totalling 820 acres, located in the northern and southern sections of the city. The Mill River is conveyed through the protected area and discharges to the Connecticut River via a pressure conduit.

The original local protection project was constructed in various segments, beginning in 1937 and ending in December 1948. The protective works consist of 3,700 feet of earth dikes, 14,700+ feet of concrete floodwalls, 1,700 feet of pressure conduit for the Mill River, wing walls along Mill River, five closure structures, one pumping station, and miscellaneous drainage structures to supplement the city systems for discharge of interior drainage. The heights of walls and levees range from one to nine feet. Six pumping stations constructed by the city were incorporated into the protective system. The project provides protection to approximately the 450-year event (i.e. a 1/450 chance of level being exceeded in any given year).

A building wall which had been part of the original flood protection project was removed and replaced by the Corps of Engineers with a combination wall/levee system.

Also, an 8-inch concrete cap was added to a 2,500 foot section of the floodwall immediately upstream of the North End Bridge. A general plan of the project is shown on Enclosure 3.

6. FLOOD HISTORY

Damaging floods have been experienced on the Connecticut River and its tributaries since the establishment of the first settlements in the basin. Records of peak flood stages on the Connecticut River at Springfield have been maintained by the National Weather Service dating back to 1869. The flood level gage is located at the Memorial Bridge, just upstream of the confluence of the Westfield River.

The USGS operates a continuous streamflow gaging station on the Connecticut River at Thompsonville, Connecticut, about eight miles downstream of Springfield. Discharges at Thompsonville are considered representative of Connecticut River flows in the lower section of Springfield.

The greatest flood of record on the lower Connecticut River was experienced in March 1936 when a stage of 28.6 feet (65.9 feet NGVD) was reached at the Springfield gage. The second greatest flood occurred in September 1938, with a level of 2.9 feet below the 1936 stage.

Most recently, in late May 1984, the Connecticut River Basin experienced intense rainfall and serious widespread flooding. The river crested at Springfield at its highest level since September 1938. The peak discharge at Thompsonville, Connecticut, was 184,000 cubic feet per second (cfs). The flood frequency of this event was estimated to be between once in 50-years and once in 100-years. The computed natural discharge at Thompsonville, Connecticut, without Corps reservoirs, would have been 222,000 cfs and the peak at Springfield would have been 60.0 feet NGVD (National Geodetic Vertical Datum).

Historic flood levels at Springfield and peak flows at Thompsonville, Connecticut are listed in Table 1.

TABLE 1
HISTORIC FLOODS
SPRINGFIELD, MASSACHUSETTS

<u>DATE</u>	<u>FLOOD LEVEL AT MEMORIAL BRIDGE</u> (ft NGVD)	<u>DISCHARGE AT THOMPSONVILLE, CT</u> (cfs)
Mar 1936	65.9	282,000
Sep 1938	63.0	236,000
Nov 1927	59.7	190,000
May 1984	59.6	184,000
Aug 1955	58.4	174,000
Apr 1960	57.3	156,000
Apr 1987	56.4	141,000*
		*(included for reference only)

The stage-discharge and stage-frequency curves at the gage at Memorial Bridge are shown as Enclosures 4 and 5, respectively. Although Springfield currently has protection against a rare flood event (approximate flood frequency of once in 450-years), estimated damages of \$226 million would result when flood waters overtop the project. The structure/type associated with this damage figure is shown on Table 2.

TABLE 2
ESTIMATED DAMAGES FROM FLOOD WATERS OVERTOPPING *
SPRINGFIELD LOCAL PROTECTION PROJECT
(MARCH 1987 PRICE LEVEL)

<u>STRUCTURE/TYPE</u>	<u>FLOOD DAMAGES (\$000)</u>
Commercial	\$75
Residential	65
Commercial/Residential	2
Industrial	63
Public, Charitable, Social	18
Utilities, Railroad, Highway	3
TOTAL	\$226

*Estimated from data collected during the Detailed Project Report, May 1982 and the newly constructed commercial structure and 46 residential structures identified in November 1986 field survey.

7. PLAN FORMULATION

The scope of this study is to investigate modifications to the existing LPP. Although the existing project was originally intended to have approximately Standard Project Flood (SPF) protection, only 16 of 23 flood storage reservoirs planned in the upper portion of the Connecticut River basin were actually constructed.

(a) FREEBOARD The opportunity for improvement to the existing LPP lies in the determination of the freeboard required for protection. Freeboard is additional vertical height over the design water surface added to the design of a dike or wall. A discussion of the history of freeboard for this project is as follows:

(1) General Description Freeboard is provided to allow for uncertainties in hydraulic computations, and to ensure that the desired degree of protection will not be reduced by unaccounted factors.

(2) Original Design Criteria A uniform freeboard of 3 feet for both concrete walls and earth embankment was originally proposed for the Springfield LPP. However, since the entire reservoir plan would not be effective for some time, the Board of Engineers for Rivers and Harbors recommended the earth section be raised an additional 2 feet; therefore, the originally adopted design freeboard was 5 feet for earth dikes and 3 feet for the concrete walls. The difference between dikes and walls is 2 feet.

(3) Present Design Criteria Present design criteria requires the inclusion of 3 feet of freeboard for earth dikes and 2 feet of freeboard for concrete walls. Less freeboard is provided for concrete walls due to their greater resistance to failure if overtopping were to occur. The difference in height between dikes and walls is 1 foot.

(b) ALTERNATIVES Based on this difference in freeboard, two alternatives of raising the existing protection at Springfield were investigated. These are: (1) Raise walls one-foot and (2) Raise walls and dikes to the Standard Project Flood (SPF) level.

(1) Raise Walls One-Foot - Due to the present two-foot difference in freeboard between walls and dikes as constructed under the original design criteria and the one-foot difference under the current criteria, raising only the walls one-foot would provide one-foot of additional protection over the entire project (see Enclosure 6). This would increase the level of flood protection from an occurrence interval of once in 450 years to once in 500 years. This plan includes providing a one-foot concrete cap on 14,700 linear feet of the existing floodwalls and wing walls (Mill River), waterproofing two existing buildings, providing additional sandbags for existing closure structures, and constructing approximately 1,650 linear feet of new concrete I-wall to tie raised floodwall sections into high ground (see Enclosure 7). The estimated first cost of this plan would be \$1.25 million as summarized in Table 3.

TABLE 3

**RAISE WALL ONE-FOOT
RECONNAISSANCE LEVEL COST ESTIMATE**

<u>ITEM</u>	<u>QUANTITY</u>	<u>UNITS</u>	<u>UNIT PRICE</u>	<u>COST</u>
One-foot Wall Cap	14,700	LF	\$24	\$352,800
New Wall	1,650	LF	248	407,200
Waterproof Building	2	Bldg	1750	3,500
Sandbags	1	LS	10,000	10,000
Subtotal				\$773,500
Contingencies				\$190,000
Lands and Damages				\$50,000
Engineering and Design				\$140,500
Supervision and Administration				<u>\$96,000</u>
Total First Cost				\$1,250,000

(2) Raise Walls and Dikes to the SPF Level - As previously discussed, the existing project was originally intended to have approximately Standard Project Flood (SPF) protection. The SPF is a flood which can be expected from the most severe combination of meteorological and hydrological conditions reasonably characteristic of the region, excluding extremely rare combinations of events. This plan involves raising existing walls approximately 5 1/2 feet and existing dikes approximately 4 1/2 feet. The estimated first cost of this plan would be \$16.6 million as summarized in Table 4.

TABLE 4

**RAISE WALLS AND DIKES TO THE SPF LEVEL
RECONNAISSANCE LEVEL COST ESTIMATE**

<u>ITEM</u>	<u>COST (\$ Million)</u>
Walls	\$13.0
Dikes	1.5
Engineering and Design	1.1
Supervision and Administration	1.0
TOTAL	<u>\$16.6</u>

8. ECONOMIC JUSTIFICATION

In order to economically justify Federal participation to increase the level of protection at Springfield, the costs of the project must exceed the benefits. Costs were previously discussed in Section 7. Benefits are equal to the reduction in potential flood damages from implementation of the flood control project.

If the existing flood protection is overtopped, the city would sustain initial flood damages of \$226 million. The expected annual damages are currently estimated at \$272,000. Table 5 summarizes the benefits and costs of current conditions and these two alternative plans:

TABLE 5
BENEFIT/COST ANALYSIS
(MARCH 1987 PRICE LEVEL, 50-year life, 8-7/8% Interest rate)

ALTERNATIVE PLAN	FIRST COST (\$000)	ANNUAL COST (\$000)	ANNUAL BENEFITS (\$000)	1/ NET BENEFITS (\$000)	2/ REMAINING ANNUAL DAMAGES (\$000)	3/ BENEFIT/ COST RATIO
No improvement	-	-	-	-	272	-
Raise wall 1 foot	1,250	113	125	12	147	1.11
Raise protection to SPF level	16,600	1,494	272	None	0	0.18

1/ Net Benefits equal annual benefits minus annual costs.

2/ Remaining Annual Damages equal current annual damages (\$272,000) minus reduction in flood damages (annual benefits).

3/ Benefit/Cost Ratio equals annual benefits divided by annual costs

Annual costs are equal to first costs amortized over a 50-year period at an interest rate of 8-7/8 percent. A cursory real estate cost estimate of \$50,000 to obtain temporary and permanent easements for the plan to raise the floodwall one-foot was approximated without a field survey or appraisal. A more accurate appraisal will be conducted during the next study phase.

As shown on Table 5, benefits only exceed costs for the plan to raise the wall one foot. To raise the level of protection higher than one foot requires not only raising the walls, but also raising the dikes. This would result in significant increases in costs compared to marginal increases in benefits. Raising the wall one-foot would be the most cost effective plan. An incremental analysis for higher levels of protection then, would not be required.

9. FUTURE CONDITIONS

In discussions with the Corps of Engineers, the city discussed its plans to extensively redevelop its waterfront area. Numerous planning activities, including reviewing plans of potential developers, have been undertaken towards this goal. Based on the projected development, the benefits of providing additional flood protection would increase.

10. ENVIRONMENTAL AND CULTURAL RESOURCES ANALYSIS

An environmental analysis to determine whether an Environmental Impact Statement (EIS) would be required if further study is recommended. However, due to the similarities between this project and a recently constructed project in West Springfield, an EIS will most likely not be required. Impacts associated with the alternative plan to raise the floodwalls one-foot would include:

- (a) Aesthetic impact of the structure;
- (b) Construction noise, dust, and traffic; and
- (c) If earth fill becomes necessary, encroachment on vegetation and wildlife habitat.

In coordination with the Massachusetts Historical Commission, it has been determined that modifying the floodwall will not significantly effect cultural, historical, or archaeological resources. No further compliance with the Advisory Council Regulations for the Protection of Cultural Resources is required.

11. REQUIREMENTS OF LOCAL COOPERATION

If the city of Springfield agreed to support the project, studies would proceed to the Definite Project Study (DPS) Phase. If the DPS results in recommendation for project implementation, non-Federal interests agree to provide required items of local cooperation, and funding is available, the plan would proceed to the preparation of Plans and Specifications for construction.

The non-Federal sponsor is required to cost share the Definite Project Study on a 50/50 basis. Up to one-half of the sponsor's share can be provided through in-kind services. The estimate of study and construction costs are shown in Table 6:

TABLE 6
ESTIMATE OF COST SHARING
STUDY AND PROJECT

	<u>STUDY COSTS</u>		<u>CONSTRUCTION COSTS</u>	
	<u>PERCENT</u>	<u>COSTS</u>	<u>PERCENT</u>	<u>COSTS</u>
NON-FEDERAL	50%	\$43,000	25%	\$312,500
FEDERAL	<u>50%</u>	<u>\$43,000</u>	<u>75%</u>	<u>\$937,000</u>
TOTAL	100%	\$86,000	100%	\$1,250,000

12. CONCLUSIONS

Reconnaissance scope studies conclude that there is sufficient economic justification and Federal interest to warrant further detailed investigations for improving the existing LPP along the Connecticut River, Springfield, Massachusetts. Raising the existing floodwalls one-foot was potentially feasible. The City of Springfield has reviewed the draft Reconnaissance Report and finds that the additional flood protection provided by the modification plan does not justify the city's share of the study and construction cost.

13. RECOMMENDATIONS

I recommend that studies to investigate the feasibility of Federal participation in modifying the existing Springfield Local Protection project, Springfield, Massachusetts be discontinued.

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosures:

- (1) Letter Requesting Study
- (2) Vicinity Map
- (3) Existing Conditions-General Plan
- (4) Stage-Discharge Curve
- (5) Stage-Frequency Curve
- (6) Sections-Raising wall
- (7) Plan View-Raising wall



THE CITY OF SPRINGFIELD, MASSACHUSETTS

MAYOR RICHARD E. NEAL

March 14, 1986

Colonel Thomas A. Rhen
Division Engineer
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Colonel Rhen:

On March 11, 1986, members of your staff met with the Springfield Riverfront Development Commission to discuss the findings of the Appraisal Report on the Springfield Local Flood Protection Project. This December 1985 report concluded that there is a potential for raising the concrete floodwall portions of the project as accomplished for our neighbors in West Springfield.

Accordingly, I request that the Corps proceed to undertake a reconnaissance report to determine the feasibility and effects of modifying the existing project. I have been informed that this study can be prepared at no cost to the City of Springfield. I also understand that any further study beyond the reconnaissance phase will require cost sharing. Any subsequent decision to proceed into more detailed planning will rely on the reconnaissance findings.

We look forward to working with you in these efforts. The City's point of contact for coordination of the Reconnaissance Study is Linda Louro, (413) 787-6020.

Sincerely,

Richard E. Neal

cc: Congressman Edward Boland
Senator Edward Kennedy
Senator John Kerry

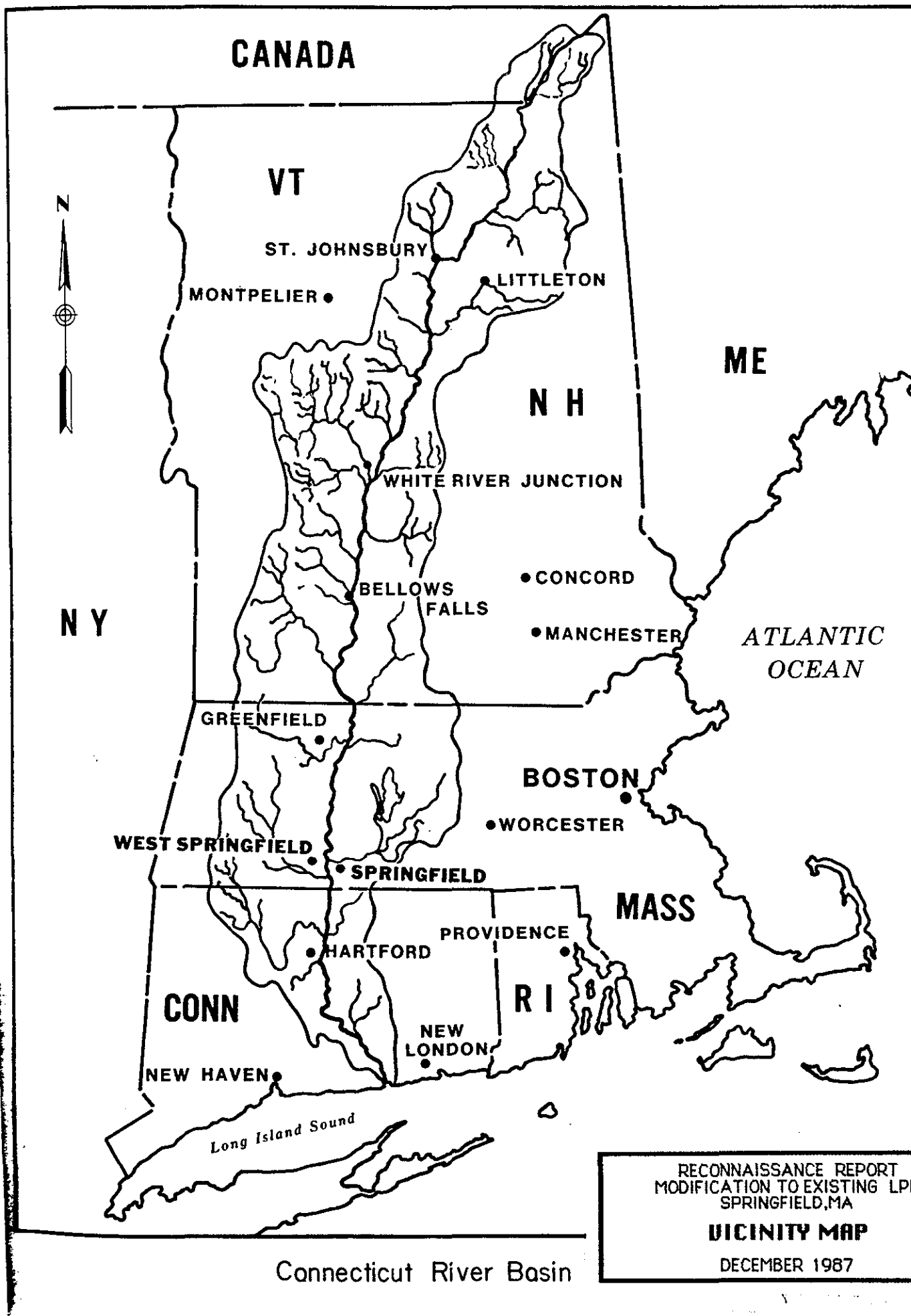
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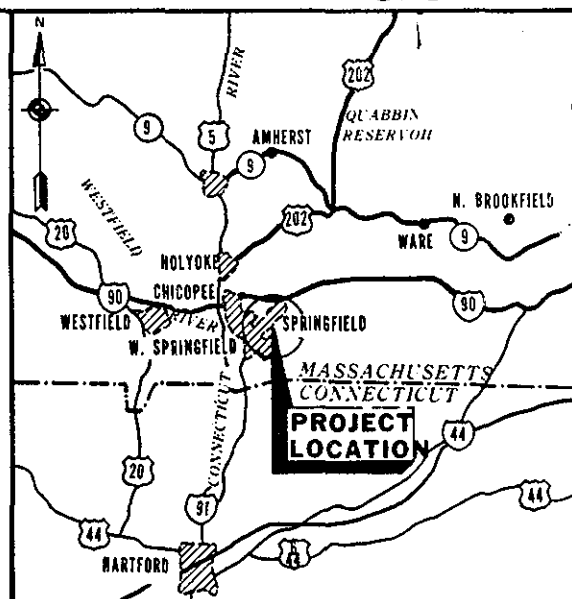
RECONNAISSANCE REPORT
MODIFICATION TO EXISTING LPP
SPRINGFIELD, MA

LETTER REQUESTING STUDY

DECEMBER 1987

ENCLOSURE 1

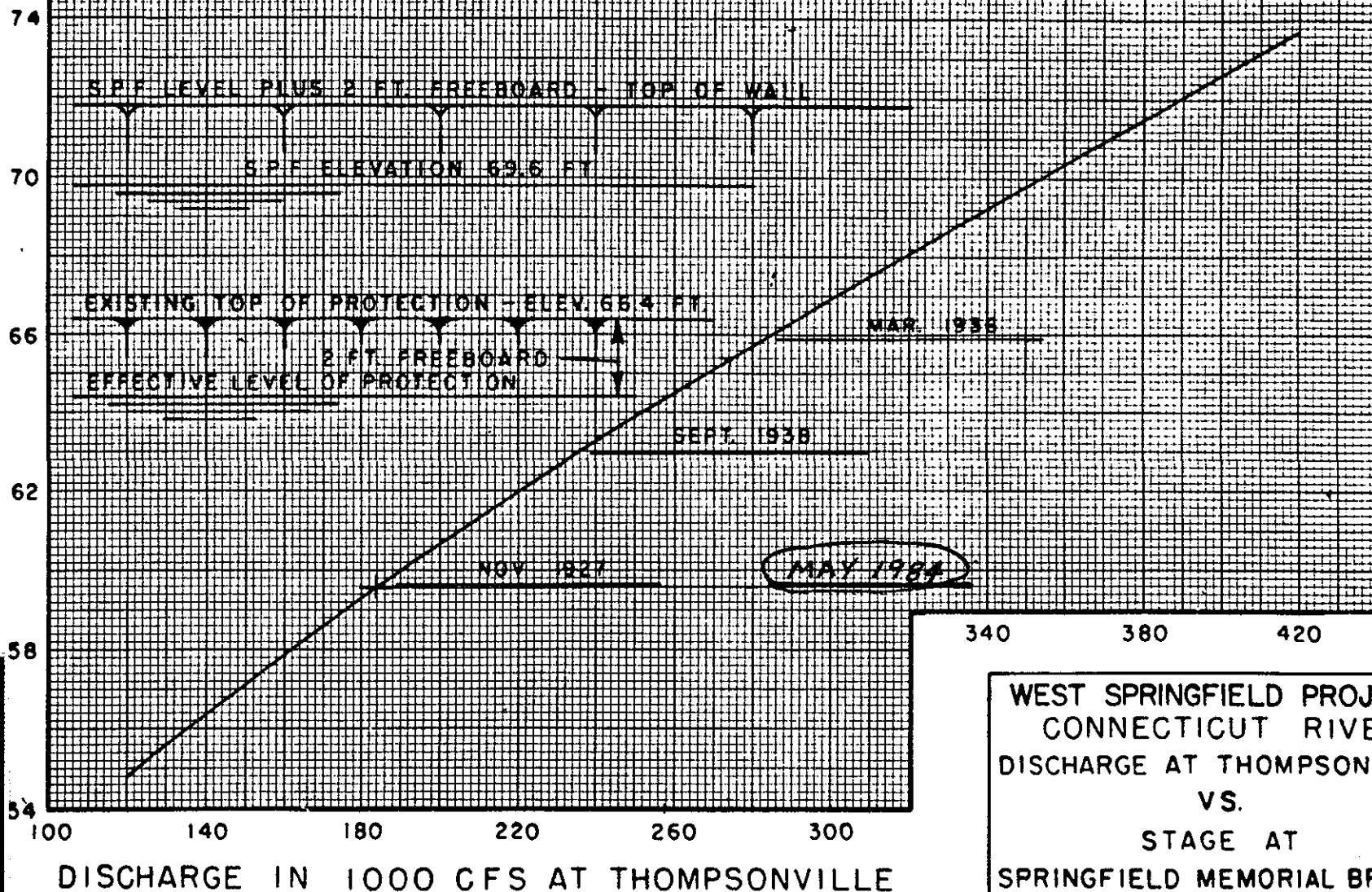




VICINITY MAP
SCALE IN MILES
1 0 1 2

NEW ENGLAND DIVISION WALTHAM, MASS.

ELEVATION IN FEET ABOVE MSL



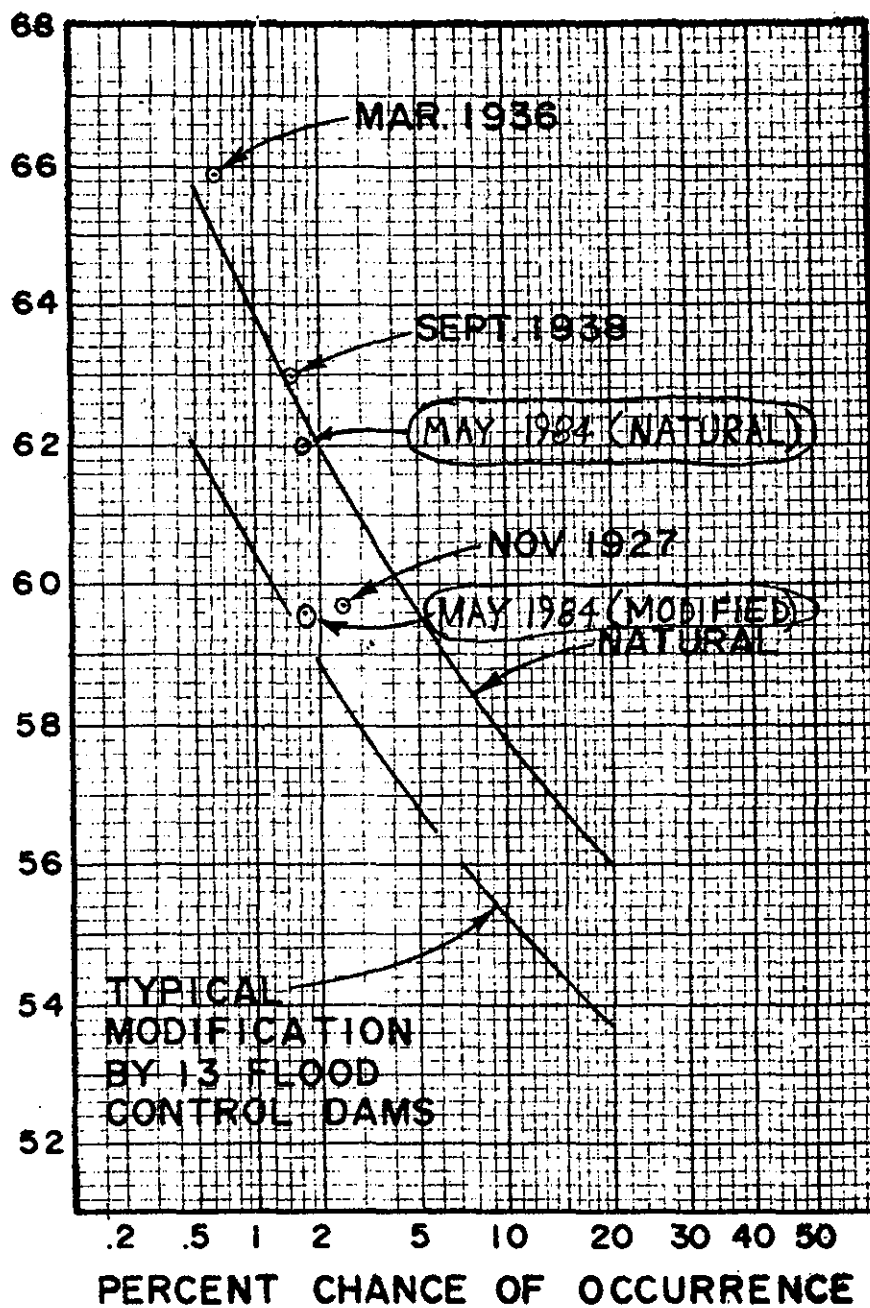
WEST SPRINGFIELD PROJECT
CONNECTICUT RIVER
DISCHARGE AT THOMPSONVILLE
VS.
STAGE AT
SPRINGFIELD MEMORIAL BRIDGE

RECONNAISSANCE REPORT
MODIFICATION TO EXISTING LPP
SPRINGFIELD, MA
STAGE-DISCHARGE CURVE

DECEMBER 1987

ENCLOSURE 4

**CONNECTICUT RIVER AT SPRINGFIELD MEMORIAL BRIDGE
ELEVATION IN FEET ABOVE M.S.L.**



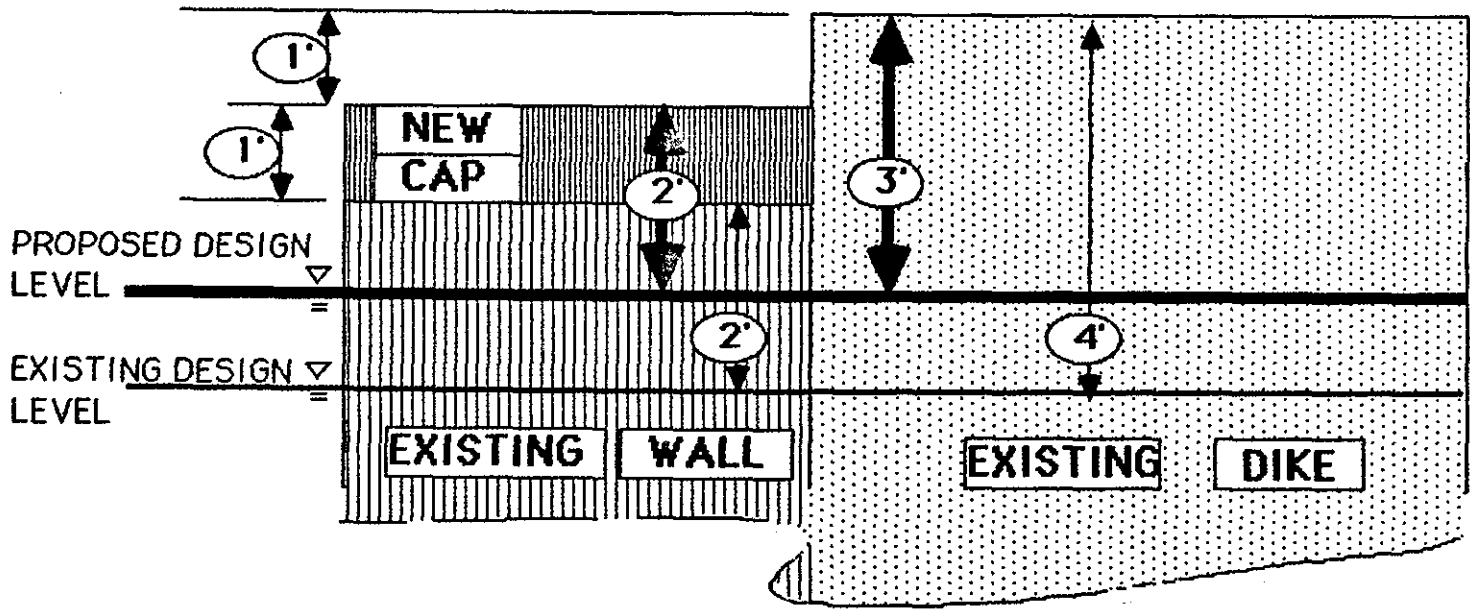
RECONNAISSANCE REPORT
MODIFICATION TO EXISTING LPP
SPRINGFIELD, MA

STAGE-FREQUENCY CURVE

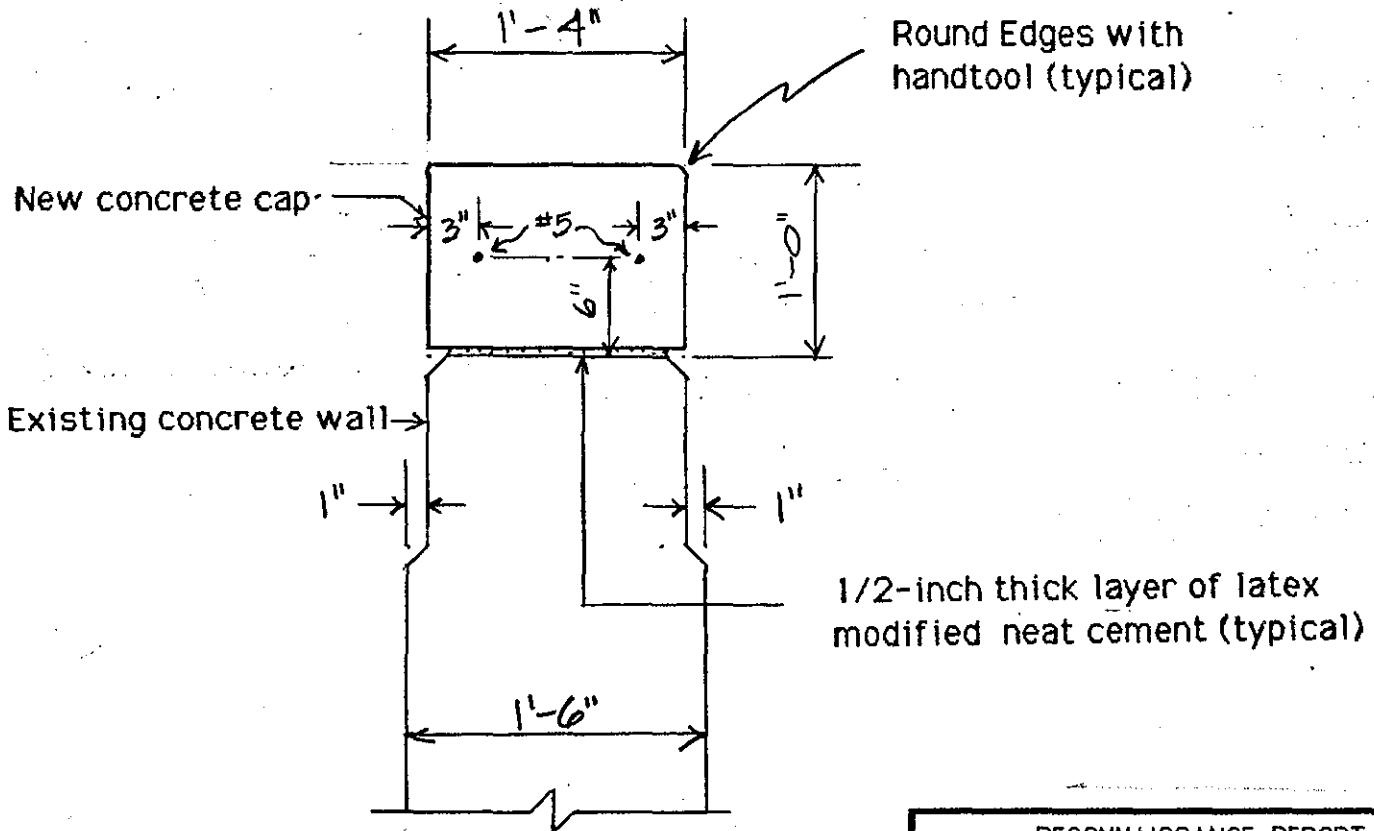
DECEMBER 1987

ENCLOSURE 5

TYPICAL PROFILE



TYPICAL WALL CAP DETAIL

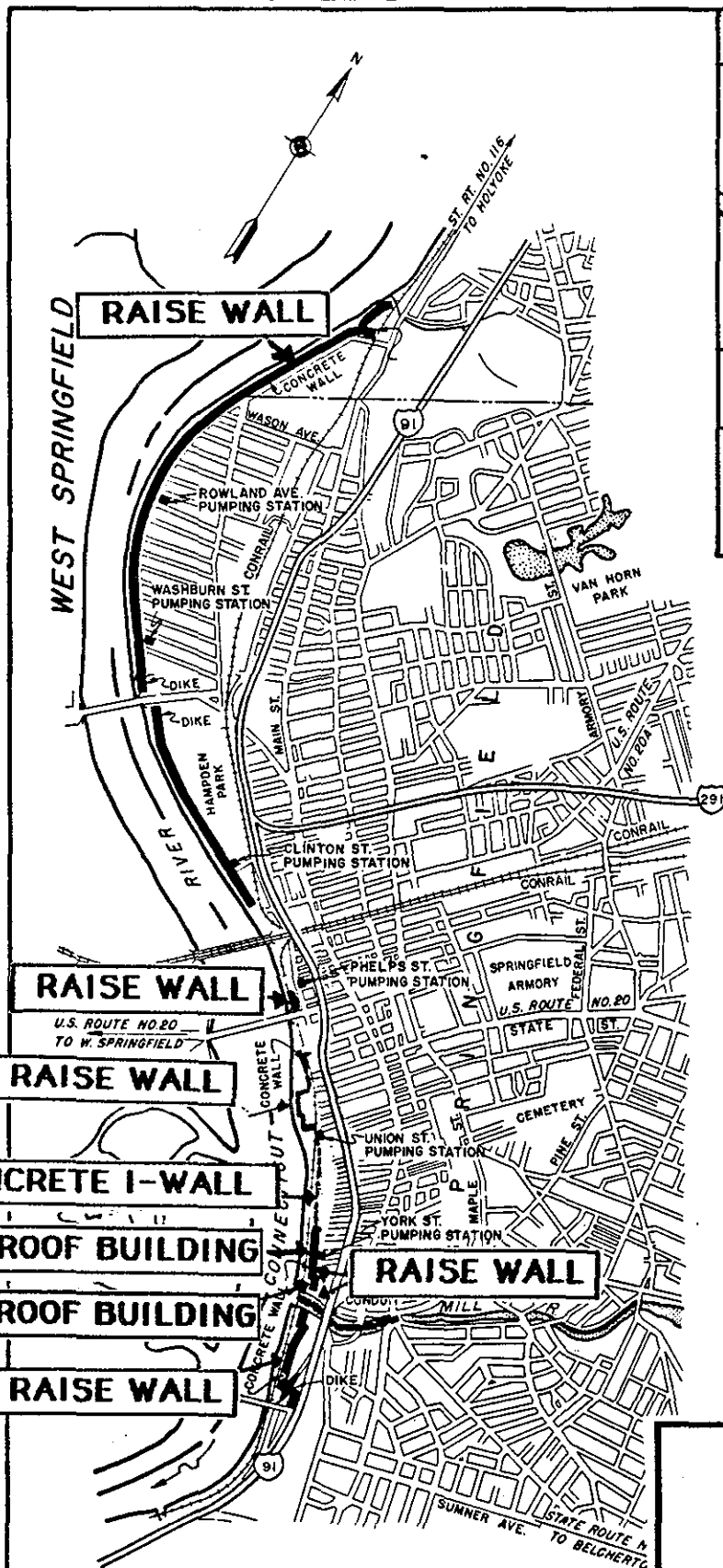


SCALE - 1in = 1 ft

RECONNAISSANCE REPORT
MODIFICATION TO EXISTING LPP
SPRINGFIELD, MA

SECTIONS-RAISING WALL

DECEMBER 1987

VICINITY MAP
SCALE IN MILES

1 0 1 2

RECONNAISSANCE REPORT
MODIFICATION TO EXISTING LPP
SPRINGFIELD, MA

PLAN VIEW-RAISING WALL

DECEMBER 1987

SCALE IN FEET
1600' 0 1600' 3200'

NEW ENGLAND DIVISION WALTHAM, MASS.

ENCLOSURE